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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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6111	7590	10/16/2003		EXAMINER
GENERAL ELECTRIC COMPANY				MARKHAM, WESLEY D
ANDREW C HESS				
GE AIRCRAFT ENGINES			ART UNIT	PAPER NUMBER
ONE NEUMANN WAY M/D H17			1762	
CINCINNATI, OH 452156301				DATE MAILED: 10/16/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/943,782	SPITSBERG ET AL.	
	Examiner	Art Unit	
	Wesley D Markham	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If no period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on _____.
- 2a) This action is **FINAL**. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-19 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on 31 August 2001 is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) The proposed drawing correction filed on _____ is: a) approved b) disapproved by the Examiner.
 If approved, corrected drawings are required in reply to this Office action.
- 12) The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) All b) Some * c) None of:
1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
 a) The translation of the foreign language provisional application has been received.
- 15) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) Notice of References Cited (PTO-892) 4) Interview Summary (PTO-413) Paper No(s). _____ .
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) Notice of Informal Patent Application (PTO-152)
- 3) Information Disclosure Statement(s) (PTO-1449) Paper No(s) 8/31/01 . 6) Other: _____ .

DETAILED ACTION

1. Claims 1 – 19 are currently pending in U.S. Application Serial No. 09/943,782, and an Office Action on the merits follows.

Information Disclosure Statement

2. The IDS filed by the applicant on 8/31/2001 is acknowledged, and the references listed thereon have been considered by the examiner as indicated on the attached, initialed copy of the IDS.

Drawings

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: "4" in Figure 2. A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

4. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed. The following title is suggested: "Fabrication of an article having a thermal barrier coating system including a pre-oxidized bond coat, and the article".

5. The use of the following trademarks has been noted in this application: RENE' N5, RENE' N6, RENE' 142, CMSX-4, CMSX-10, PWA1480, PWA1484, and MX-4 (see pages 6 – 7 of the specification). They should be capitalized wherever they appear and be accompanied by the generic terminology. Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner that might adversely affect their validity as trademarks.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

7. Claims 1 – 5, 9, 10, 14, and 15 are rejected under 35 U.S.C. 102(a) as being anticipated by Schaeffer et al. (USPN 6,123,997).

8. Regarding independent Claim 1 (from which Claims 2 – 15 depend), Schaeffer et al. teaches a method of fabricating an article protected by a thermal barrier coating (TBC) system (Abstract), the method comprising the steps of providing an article substrate having a substrate surface (Figure 2, reference number "22", Col.3, lines 6 – 12, and Col.4, lines 19 – 54), thereafter producing a pre-oxidized bond coat on the substrate surface, the step of producing the pre-oxidized bond coat including the steps of (1) depositing a bond coat on the substrate surface, the bond coat having a

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bond coat surface (Figure 2, reference number "24", and Col.3, lines 14 – 50), and (2) controllably oxidizing the bond coat surface to form a pre-oxidized bond coat surface (Figure 2, reference number "28", Col.3, line 15, Col.4, lines 55 – 67, and Col.5, lines 1 – 48), and thereafter depositing a TBC overlying the pre-oxidized bond coat surface, the TBC comprising yttria-stabilized zirconia (YSZ) having a yttria content of from about 3 percent by weight to about less than 6 percent by weight of the YSZ (Figure 2, reference number "26", Col.3, lines 14 – 17 and 51 – 67 (especially lines 53 – 56), Col.4, lines 1 – 19, and Col.5, lines 12 – 15).

9. Schaeffer et al. also teaches all the limitations of Claims 2 – 5, 9, 10, 14, and 15 as set forth above in paragraph 8 and below, including a method wherein / further comprising:

- Claim 2: The article substrate comprises a nickel-base superalloy (Col.3, lines 9 – 10, and Col.4, lines 19 – 54).
- Claim 3: The article substrate comprises a component of a gas turbine engine (Col.1, lines 24 – 65, Col.3, lines 6 – 8, and Col.4, lines 18 – 19).
- Claims 4 and 5: The step of depositing the bond coat includes the step of depositing a diffusion aluminide bond coat (Claim 4) or a platinum aluminide bond coat (Claim 5) (Col.3, lines 28 – 32).
- Claim 9: The step of controllably oxidizing the bond coat includes heating the bond coat to an oxidizing temperature of from about 1800° F to about 2100° F (Col.5, lines 16 – 21).

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- Claim 10: The step of controllably oxidizing the bond coat includes heating the bond coat to an oxidizing temperature for a time of from about ½ hour to about 3 hours (Col.5, lines 16 – 21).
- Claim 14: The TBC is deposited by physical vapor deposition (PVD) (Col.4, lines 1 – 2).
- Claim 15: The TBC has a yttria content from about 3.8 to about 4.2 percent by weight of the YSZ (Col.3, lines 53 – 56).

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

12. Claims 6 – 8, 11 – 13, and 16 – 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schaeffer et al. (USPN 6,123,997).

13. Schaeffer et al. explicitly teaches all the limitations of Claims 6 – 8 and 11 as set forth above in paragraphs 8 and 9, except for a method wherein the step of controllably oxidizing the bond coat includes the step of heating the bond coat in an atmosphere having a partial pressure of oxygen of from about 10^{-5} mbar to about 10^3 mbar (Claim 6), specifically about 10^{-5} mbar to about 10^{-2} mbar (Claim 7), more specifically about 10^{-4} mbar (Claims 8 and 11). Please note that, regarding Claim 11, Schaeffer et al. does teach heating the bond coat to a temperature of from about 2000° F to about 2100° F for a time of from about ½ hour to about 3 hours (Col.5, lines 12 – 21). Additionally, Schaeffer et al. does teach heating and controllably oxidizing the bond coat in an “oxygen-rich environment”, which Schaeffer et al. defines as an atmosphere having an oxygen partial pressure greater than 10^{-33} atm (i.e., greater than about 10^{-30} mbar) (Col.5, lines 12 – 33). The oxygen partial pressure range taught by Schaeffer et al. encompasses the applicant’s claimed pressure range(s) / value(s). Since Schaeffer et al. teaches controllably oxidizing the bond coat in an atmosphere having an oxygen partial pressure greater than 10^{-33} atm (i.e., greater than about 10^{-30} mbar), it would have been obvious to one of ordinary skill in the art to utilize any oxygen partial pressure value, including values claimed by the applicant (e.g., about 10^{-4} mbar) or within the applicant’s claimed ranges, within the range disclosed by Schaeffer et al. with the reasonable expectation of successfully and advantageously oxidizing the bond coat in an

"oxygen-rich environment", as desired by Schaeffer et al. One of ordinary skill in the art would have reasonably expected that utilizing relatively high oxygen partial pressure values would lead to faster oxidation than utilizing relatively low oxygen partial pressure values and would have chosen the oxidation conditions accordingly, so long as an "oxygen-rich environment" is utilized, as desired by Schaeffer et al. Please note that a prior art reference that discloses a range encompassing a somewhat narrower claimed range is sufficient to establish a *prima facie* case of obviousness (*In re Peterson*, 315 F.3d 1325, 1130, 65 USPQ2d 1379, 1382-83 (Fed. Cir. 2003)).

14. Schaeffer et al. teaches all the limitations of Claims 12 and 13 as set forth above in paragraphs 8 – 9, except for a method wherein the steps of depositing the bond coat and controllably oxidizing the bond coat are performed concurrently (Claim 12), or the step of controllably oxidizing the bond coat is performed after the step of depositing the bond coat (Claim 13). However, Schaeffer et al. does teach that the alumina scale (i.e., the layer produced by the oxidation of the bond coat) is formed "in situ", and the oxidation of the bond coat occurs before the deposition of the TBC (Col.3, lines 14 – 16, and Col.5, lines 12 – 15). Schaeffer et al. is silent regarding the specific time period before the deposition of the TBC that the bond coat is oxidized. However, under these circumstances taught by Schaeffer et al. (i.e., that the oxidation of the bond coat occurs before the deposition of the TBC), there are only two possible time periods during which the bond coat could be oxidized – (1) during the deposition of the bond coat and before the deposition of the TBC, and (2) after

the deposition of the bond coat and before the deposition of the TBC. Since the bond coat must be oxidized during at least one of these time periods in order to achieve the pre-oxidized bond coat desired by Schaeffer et al., it would have been obvious to one of ordinary skill in the art to oxidize the bond coat either concurrently with or after the deposition of the bond coat with the reasonable expectation of success and obtaining similar results (i.e., successfully oxidizing the bond coat to form an adherent alumina scale, regardless of whether the oxidation is done after the deposition or concurrently with the deposition). Both alternatives would be expected by one of ordinary skill in the art to have different advantages. For example, by performing the deposition and oxidation concurrently, a separate oxidation step would not be required, thereby advantageously reducing processing time; however, by performing the oxidation as a separate step after the deposition, there would be less process variables to simultaneously regulate, thereby advantageously allowing the oxidation process to be more exactly and precisely controlled.

15. Regarding independent Claim 16 (from which Claims 17 – 19 depend), this claim mirrors independent Claim 1 (which has been discussed at length in paragraph 8 above) and additionally requires that (1) the substrate be a nickel-base superalloy, (2) the substrate comprise a component of a gas turbine engine, (3) the bond coat be platinum aluminide, and (4) the oxidation step be performed after the bond coat deposition step. These limitations are also taught / reasonably suggested by Schaeffer et al. (see the discussion of Claims 2, 3, 5, and 13 in paragraphs 9 and 14

above). Regarding Claim 17, Schaeffer et al. does not explicitly teach that the step of controllably oxidizing the bond coat includes the step of heating the bond coat in an atmosphere having a partial pressure of oxygen of from about 10^{-5} mbar to about 10^3 mbar. However, this limitation would have been obvious to one of ordinary skill in the art for the reasons set forth above in paragraph 13. Regarding Claim 18, Schaeffer et al. teaches that the step of controllably oxidizing the bond coat includes heating the bond coat to an oxidizing temperature of from about 1800° F to about 2100° F (Col.5, lines 16 – 21). Regarding Claim 19, Schaeffer et al. teaches that the TBC has a yttria content from about 3.8 to about 4.2 percent by weight of the YSZ (Col.3, lines 53 – 56).

16. Claims 1 – 9 and 13 – 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Duderstadt et al. (USPN 5,238,752) in view of Bruce et al. (USPN 5,981,088).

17. Regarding independent Claims 1 and 16, Duderstadt et al. teaches a method of fabricating an article protected by a TBC system (Abstract), the method comprising the steps of providing an article substrate, specifically a nickel-base superalloy article substrate comprising a component of a gas turbine engine, having a substrate surface (Figure 1, Figure 2, reference number “22”, Col.1, lines 6 – 32, Col.2, lines 32 – 36, Col.4, lines 39 – 60, and Col.8, lines 28 – 46), thereafter producing a pre-oxidized bond coat on the substrate surface, the step of producing the pre-oxidized bond coat including the steps of (1) depositing a bond coat, specifically a platinum aluminide bond coat, on the substrate surface, the bond coat having a bond coat

surface (Figures 2 and 3, reference number "24", Col.2, lines 45 – 53 and 68, Col.3, lines 1 – 3 and 24 – 28, Col.5, lines 35 – 68, and Col.6, lines 1 – 44), and (2) thereafter, controllably oxidizing the bond coat surface to form a pre-oxidized bond coat surface (Figures 2 and 3, reference number "28", Col.2, lines 53 – 55, Col.3, lines 45 – 61, Col.6, lines 45 – 59, and Col.7, lines 27 – 38), and thereafter, depositing a TBC overlying the pre-oxidized bond coat surface, the TBC comprising YSZ (Figures 2 and 3, reference number "30", Col.2, lines 57 – 62, Col.3, lines 59 – 67, Col.4, lines 1 – 6, Col.7, and Col.8, lines 1 – 17). Duderstadt et al. does not explicitly teach that the YSZ has a yttria content of from about 3% by weight to about less than 6% by weight of the YSZ. Specifically, the yttria content in the YSZ taught by Duderstadt et al. is about 6 to 20% by weight (Abstract, Col.2, lines 56 – 60, and Col.7, lines 1 – 10). Bruce et al. teaches a TBC system to be utilized as a protective coating on gas turbine engine components (Abstract). The ceramic TBC layer is formed of YSZ having a columnar grain structure, the YSZ preferably containing about 2 to 5% by weight of yttria (Abstract). Importantly, Bruce et al. also teaches that, by using YSZ having a yttria content of less than 6% by weight, specifically about 2 to 5% by weight, the TBC system exhibits superior spallation resistance and adhesion when compared to conventional YSZ TBCs, such as 7%YSZ (Col.1, lines 5 – 11 and 63 – 66, Col.2, lines 39 – 50, Col.3, lines 37 – 50, and Col.4, lines 1 – 33 and 46 – 53). Therefore, it would have been obvious to one of ordinary skill in the art to deposit a YSZ TBC having a yttria content of about 2 to 5% by weight (i.e., a weight percent within the applicant's claimed range), as taught by Bruce et al., in the

process of Duderstadt et al. as opposed to a YSZ TBC having a higher yttria content, such as about 6 to 20% by weight (as taught by Duderstadt et al.), with the reasonable expectation of successfully and advantageously producing a TBC on a gas turbine engine component that exhibits superior adhesion and spallation resistance, thereby increasing the life of the component.

18. The combination of Duderstadt et al. and Bruce et al. also teaches all the limitations of Claims 2 – 9, 13 – 15, and 17 – 19 as set forth above in paragraph 17 and below, including a method wherein / further comprising:

- Claims 2 and 3: The article substrate comprises a nickel-base superalloy (Claim 2) and a component of a gas turbine engine (Claim 3) (Figure 1, Figure 2, reference number “22”, Col.1, lines 6 – 32, Col.2, lines 32 – 36, Col.4, lines 39 – 60, and Col.8, lines 28 – 46 of Duderstadt et al.).
- Claims 4 and 5: The step of depositing the bond coat includes the step of depositing a diffusion aluminide bond coat (Claim 4) or a platinum aluminide bond coat (Claim 5) (Col.3, lines 10 – 44, Col.5, lines 36 – 68, and Col.6, lines 1 – 22 of Duderstadt et al., and Col.1, lines 26 – 32 of Bruce et al.).
- Claims 6 – 8 and 17: The step of controllably oxidizing the bond coat includes the step of heating the bond coat in an atmosphere having a partial pressure of oxygen of from about 10^{-5} mbar to about 10^3 mbar (Claims 6 and 17), specifically about 10^{-5} mbar to about 10^{-2} mbar (Claim 7), more specifically about 10^{-4} mbar (Claim 8). Specifically, Duderstadt et al. teaches that the preferred oxidizing atmosphere in which to heat the bond coat is air at a

pressure of 5×10^{-5} Torr (Col.7, lines 30 – 38). An air pressure of 5×10^{-5} Torr is equivalent to an air pressure of about 6.6×10^{-5} mbar. Since air is approximately 21% oxygen, the partial pressure of oxygen in the oxidizing atmosphere of Duderstadt et al. is equal to: $(0.21)(6.6 \times 10^{-5}) =$ about 1.38×10^{-5} mbar. This value is within the range claimed by the applicant in Claims 6, 7, and 17. Further, the examiner has reasonably interpreted an oxygen partial pressure of about 1.38×10^{-5} mbar, as taught by Duderstadt et al., to be “about 10^{-4} mbar”, as required by applicant’s Claim 8. In the alternative (i.e., if the applicant intends to exclude a value of about 1.38×10^{-5} mbar by reciting “about 10^{-4} mbar”), it is the examiner’s position that it would have been obvious to one of ordinary skill in the art to slightly increase the oxygen partial pressure (i.e., concentration) in the oxidation process of Duderstadt et al. (e.g., to about 10^{-4} mbar) with the reasonable expectation of successfully and advantageously increasing the speed at which the oxidation process is performed, thereby reducing processing time. Please note that, generally, differences in concentration will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating that such concentration is critical (MPEP 2144.05(II)(A)).

- Claims 9 and 18: The step of controllably oxidizing the bond coat includes heating the bond coat to an oxidizing temperature of from about 1800° F to about 2100° F (Col.7, line 35 of Duderstadt et al.).

- Claim 13: The step of controllably oxidizing the bond coat is performed after the step of depositing the bond coat (Col.3, lines 45 – 51 of Duderstadt et al.).
- Claim 14: The TBC is deposited by PVD (Col.3, lines 62 – 68, and Col.7, lines 13 – 15 of Duderstadt et al., and Abstract of Bruce et al.).
- Claims 15 and 19: The TBC has a yttria content from about 3.8 to about 4.2 percent by weight of the YSZ (Col.4, lines 15 – 60 of Bruce et al.).

19. Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Duderstadt et al. (USPN 5,238,752) in view of Bruce et al. (USPN 5,981,088), and in further view of Schaeffer et al.(2) (USPN 5,780,110).

20. The combination of Duderstadt et al. and Bruce et al. teaches all the limitations of Claims 10 and 11 as set forth above in paragraphs 17 and 18, except for a method wherein the step of controllably oxidizing the bond coat includes the step of heating the bond coat to an oxidizing temperature for a time of from about $\frac{1}{2}$ hour to about 3 hours (Claims 10 and 11) and to a temperature of from about 2000° F to about 2100° F (Claim 11). Please note that Duderstadt et al. does teach / reasonably suggest heating the bond coat in an atmosphere having a partial pressure of oxygen of about 10^{-4} mbar, as required by Claim 11 (see the discussion of Claim 8 in paragraph 18 above). Additionally, Duderstadt et al. teaches that the oxidation can be accomplished by heating the bond coat for a period of up to about 10 minutes at a temperature of about 1800° F (Col.7, lines 27 – 38). Duderstadt et al. teaches that this heating temperature and time is sufficient to oxidize the bond coat to a thickness

of about 2×10^{-5} inches, which is the most preferred thickness (Col.7, lines 35 – 38). However, Duderstadt et al. also teaches that the layer of aluminum oxide (i.e., the oxidized bond coat) can be much thicker, such as 1.2×10^{-4} inches thick (i.e., almost ten times as thick as the most preferred thickness) (Col.2, lines 53 – 56). Schaeffer et al.(2) teaches that, in the art of pre-oxidizing a bond coat prior to the deposition of a TBC (i.e., a process analogous to that of Duderstadt et al.), the pre-oxidation should occur at temperatures above 1000° C (1832° F) and for times greater than 1 hour in oxygen rich environments (Col.4, lines 47 – 57). The temperature range taught by Schaeffer et al.(2) encompasses the applicant's claimed range, and the oxidation time taught by Schaeffer et al.(2) is squarely within the applicant's claimed range. Additionally, the oxidation temperature and time taught by Schaeffer et al.(2) are higher and longer, respectively, than the oxidation temperature and time taught by Duderstadt et al. It would have been obvious to one of ordinary skill in the art to utilize the bond coat oxidation temperature and time taught by Schaeffer et al.(2) (and claimed by the applicant) in the process of Duderstadt et al. with the reasonable expectation of successfully and advantageously oxidizing the bond coat to form an alumina scale having a thickness desired by Duderstadt et al. (e.g., a thickness such as 1.2×10^{-4} inches – much thicker than the 2×10^{-5} inches thick oxidation layer taught by Duderstadt et al. to be formed at a temperature of 1800° F and a time of up to 10 minutes). One of ordinary skill in the art would have used the higher oxidation temperature and longer oxidation time taught by Schaeffer et al.(2)

in the situation wherein the oxidized bond coat is desired to be thicker than that produced by the oxidation conditions explicitly disclosed by Duderstadt et al.

21. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Duderstadt et al. (USPN 5,238,752) in view of Bruce et al. (USPN 5,981,088), and in further view of Strangman (USPN 5,514,482).

22. The combination of Duderstadt et al. and Bruce et al. teaches all the limitations of Claim 12 as set forth above in paragraph 17, except for a method wherein the steps of depositing the bond coat and controllably oxidizing the bond coat are performed concurrently. Specifically, Duderstadt et al. teaches that the bond coat is oxidized after it is deposited. However, Strangman teaches that, in the art of oxidizing an aluminide bond coat in a TBC system to form alumina scale (i.e., a process analogous to that of Duderstadt et al.), the alumina scale may generally be formed before the ceramic TBC is applied (Col.4, lines 3 – 31). The exact time period during which the alumina scale is formed on the bond coat does not appear to be limited in the process of Strangman et al. However, under the circumstances taught by Strangman (i.e., that the alumina scale is formed on the bond coat before the deposition of the TBC), there are only two possible time periods during which the bond coat could be oxidized – (1) during the deposition of the bond coat and before the deposition of the TBC, and (2) after the deposition of the bond coat and before the deposition of the TBC. Since the bond coat must be oxidized during at least one of these time periods in order to achieve the pre-oxidized bond coat desired by

Duderstadt et al., it would have been obvious to one of ordinary skill in the art to oxidize the bond coat either concurrently with or after the deposition of the bond coat with the reasonable expectation of success and obtaining similar results (i.e., successfully oxidizing the bond coat to form an adherent alumina scale, regardless of whether the oxidation is done after the deposition or concurrently with the deposition). Both alternatives would be expected by one of ordinary skill in the art to have different advantages. For example, by performing the deposition and oxidation concurrently, a separate oxidation step would not be required, thereby advantageously reducing processing time; however, by performing the oxidation as a separate step after the deposition, there would be less process variables to simultaneously regulate, thereby advantageously allowing the oxidation process to be more exactly and precisely controlled

23. Claims 1 – 3, 12, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Beele (USPN 6,127,048) in view of Bruce et al. (USPN 5,981,088).
24. Regarding independent Claim 1 and Claim 12, Beele teaches a method of fabricating an article protected by a TBC system (Abstract and Col.1, lines 16 – 22), the method comprising the steps of providing an article substrate having a substrate surface (Figure 1, reference number “1”, Col.1, lines 16 – 17, and Col.6, lines 4 – 18), thereafter, producing a pre-oxidized bond coat on the substrate surface, the step of producing the pre-oxidized bond coat including the steps of depositing a

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bond coat on the substrate surface, the bond coat having a bond coat surface, and controllably oxidizing the bond coat surface to form a pre-oxidized bond coat surface, wherein the steps of depositing the bond coat and oxidizing the bond coat are performed concurrently (Figure 1, reference number "3", Col.4, lines 60 – 67, Col.5, lines 13 – 26, Col.6, lines 25 – 26, 35 – 40, and 54 – 67, and Col.7, lines 1 – 15), and thereafter, depositing a TBC overlying the pre-oxidized bond coat surface, the TBC comprising a "partly stabilized zirconia" (Figure 1, reference number "2", Col.3, lines 52 – 56, Col.5, lines 27 – 31, Col.6, lines 19 – 24, and Col.7, lines 16 – 20). Please note that the examiner has interpreted the first oxide anchoring layer "3" of Beele to be the "bond coat" of the applicant's claims, and the second oxide layer "2" of Beele to be the "thermal barrier coating overlying the pre-oxidized bond coat surface" of the applicant's claims. Beele does not explicitly teach that the TBC is YSZ having a yttria content of from about 3% by weight to about less than 6% by weight of the YSZ. However, Beele does teach that the oxide layer "2" (i.e., the TBC) should be made of a columnar grained oxide ceramic such as partially stabilized zirconia and can be deposited by PVD (Col.6, lines 19 – 24, and Col.7, lines 16 – 20). Bruce et al. teaches a TBC system to be utilized as a protective coating on gas turbine engine components (Abstract). The ceramic TBC layer is formed of YSZ having a columnar grain structure, the YSZ preferably containing about 2 to 5% by weight of yttria (Abstract). Importantly, Bruce et al. also teaches that, by using YSZ having a yttria content of less than 6% by weight, specifically about 2 to 5% by weight, the TBC system exhibits superior spallation resistance and adhesion when

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compared to conventional YSZ TBCs, such as 7%YSZ (Col.1, lines 5 – 11 and 63 – 66, Col.2, lines 39 – 50, Col.3, lines 37 – 50, and Col.4, lines 1 – 33 and 46 – 53). Therefore, it would have been obvious to one of ordinary skill in the art to deposit a YSZ TBC having a yttria content of about 2 to 5% by weight (i.e., a weight percent within the applicant's claimed range), as taught by Bruce et al., as the "partially stabilized zirconia" layer "2" in the process of Beele with the reasonable expectation of successfully and advantageously producing a TBC that exhibits superior adhesion and spallation resistance, thereby increasing the life of the coating / component. The combination of Beele and Bruce et al. also teaches that the article substrate comprises a nickel-base superalloy and a component of a gas turbine engine (Claims 2 and 3) (Figures 1 – 2, Col.4, lines 8 – 10 and 25 – 26, and Col.6, lines 4 – 17 of Beele), the TBC is deposited by PVD (Claim 14) (Col.7, lines 16 – 20 of Beele, and Col.3, lines 37 – 46 of Bruce et al.), and the TBC has a yttria content from about 3.8 to about 4.2 percent by weight of the YSZ (Claim 15) (Col.4, lines 15 – 60 of Bruce et al.).

Double Patenting

25. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759

F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969). A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b). Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

26. Claims 1 – 11 and 13 – 19 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1 – 16 of U.S. Patent No. 6,576,067 B2 in view of Bruce et al. (USPN 5,981,088).
27. Specifically, Claims 1 – 16 of U.S. Patent No. 6,576,067 B2 teach all the limitations of Claims 1 – 11 and 13 – 19 of the instant application, as well as teaching additional process steps such as polishing and controllably roughening the bond coat surface, except the limitation that the TBC overlying the pre-oxidized bond coat surface comprises YSZ having a yttria content of from about 3 percent by weight to about less than 6 percent by weight of the YSZ, particularly from about 3.8 to about 4.2 percent by weight. Specifically, Claims 1 – 16 of U.S. Patent No. 6,576,067 B2 are silent as to the nature of the TBC (see Claims 9 and 15 of U.S. Patent No. 6,576,067 B2). However, depositing a YSZ TBC having a yttria content in the range claimed by

the applicant would have been obvious to one of ordinary skill in the art in light of the teachings of Bruce et al. for the reasons set forth in paragraph 17 above (i.e., producing a TBC system on a gas turbine engine component that exhibits superior adhesion and spallation resistance, thereby increasing the life of the component).

28. Claims 1 – 11 and 13 – 19 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1 – 22 of U.S. Patent No. 6,565,672 B2 in view of Bruce et al. (USPN 5,981,088).
29. Specifically, Claims 1 – 22 of U.S. Patent No. 6,565,672 B2 teach all the limitations of Claims 1 – 11 and 13 – 19 of the instant application, as well as teaching additional process steps such as flattening the bond coat surface, except the limitation that the TBC overlying the pre-oxidized bond coat surface comprises YSZ having a yttria content of from about 3 percent by weight to about less than 6 percent by weight of the YSZ, particularly from about 3.8 to about 4.2 percent by weight. Specifically, Claims 1 – 22 of U.S. Patent No. 6,565,672 B2 are silent as to the nature of the TBC (see Claim 22 of U.S. Patent No. 6,565,672 B2). However, depositing a YSZ TBC having a yttria content in the range claimed by the applicant would have been obvious to one of ordinary skill in the art in light of the teachings of Bruce et al. for the reasons set forth in paragraph 17 above (i.e., producing a TBC system on a gas turbine engine component that exhibits superior adhesion and spallation resistance, thereby increasing the life of the component).

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Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Solfest et al. (USPN 4,916,022), Schaeffer et al.(3) (USPN 5,891,267), Bose et al. (USPN 6,284,390 B1), and Murphy (USPN 5,856,027) all teach various processes for depositing TBC systems on gas turbine engine components, the processes comprising controllably oxidizing a bond coat prior to or during the deposition of a ceramic TBC.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (703) 308-7557. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (703) 308-2333. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Wesley D Markham
Examiner
Art Unit 1762

WDM


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